sources of CN groups may have been necessary if the early Earth had a nonreducing environment.

New laboratory results indicate that carbon, nitrogen, oxygen, and hydrogen are active participants in the carrier of the interstellar 4.62-micron band. Results show that ion bombardment of interstellar ice analogs readily produces a band in laboratory residues that is remarkably similar in profile and peak position to that seen in the dense interstellar medium. A shift in band position resulting from deuterium substitution demonstrates that hydrogen is a component of the carrier in the laboratory-produced 4.62-micron band. This finding is in contrast to premature identifications of the isocyanate anion, OCN^-, published recently by other groups. Irradiation of ices through ion bombardment allows testing mixtures that include solid nitrogen, N_2, a possible source of the available nitrogen in dense cloud ices. If the atmosphere of the early Earth were not overly reducing, as some studies indicate, extraterrestrial sources of CN-bearing molecules may have been necessary for the origin of life, the *in situ* production of prebiotic molecules containing the cyanogen bond would have been difficult. Therefore, the identification of the interstellar 4.62-micron band may include the identification of an extraterrestrial source of CN.

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Identification of Hydrocarbons in the Diffuse Interstellar Medium

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Of relevance to both astrophysics and astrobiology is the nature and evolution of organic material in the interstellar medium (ISM), because the "final" material available for incorporation into planetary systems will determine, in part, the composition of primitive planetesimal bodies, including those capable of delivering organic material to planets within habitable zones. One interstellar feature of primary relevance, the 3.4-micron hydrocarbon absorption band, has been the focus of a recent investigation into the origin and evolution of the carbonaceous component of the diffuse ISM. The remarkable similarity of the interstellar 3.4-micron band to that seen in the extract of carbonaceous meteorites has further spurred the interest in the origin of the $-CH_2-$ and $-CH_3$ groups that result in the interstellar band.

Organic residues created in the laboratory, through the energetic processing of ice mixtures and through electric discharge experiments on hydrocarbon plasmas, have resulted in many claims of spectral matches to the interstellar 3.4-micron band. The laboratory work has been essential in revealing much about the nature of the carrier, and there is consensus that the interstellar band arises from saturated aliphatic hydrocarbons. However, the exact identity of the species responsible for the interstellar band has not yet been revealed. In an effort to further constrain the properties of the true carrier of the interstellar bands, the 3.4-micron laboratory band has been investigated further through the compilation of a database of hydrocarbon candidates from astrophysics laboratories around the world. The laboratory candidates have been compared in detail over the 2- to 9-micron range to the interstellar data from ground-based, airborne, and space observations. Many candidate materials can now be ruled out on the basis of constraints placed upon them from the interstellar data. The interstellar line of sight used in this comparison is toward a star that lies behind the primarily diffuse interstellar medium dust; therefore, contributions from dense molecular cloud ices are insignificant. The Infrared Space Observatory has provided a comprehensive view of this sight line, and it reveals the absence of any strong absorption bands in the 5- to 8-micron portion of the interstellar spectrum. The upper limit of the hydrocarbon bands in the 5- to 8-micron region to those detected at 3.4 microns provides useful constraints upon the laboratory residues. Most of the laboratory residues yield large absorptions in the 5- to 8-micron region, especially those produced through the processing of ices. The most likely candidates remaining are those produced through plasma processing of hydrocarbons. This finding is consistent with recent reports of the 3.4-micron hydrocarbon absorption detected in the outflow of a carbon star rich in the acetylene (C_2H_2) molecule. Observations of additional interstellar lines of sight through diffuse interstellar medium dust and additional laboratory experiments aimed at the questions posed in this study will be the next steps along the path toward identifying the hydrocarbons in the diffuse ISM. Dust from the diffuse ISM is incorporated into dense molecular clouds, out of which the next generation of stars and planetary systems form. Identification of the diffuse ISM hydrocarbons, which appear so similar to those seen in carbonaceus meteorites, is important to pursue.

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The SOFIA Water-Vapor Monitor

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The Stratospheric Observatory for Infrared Astronomy (SOFIA), a 3-meter class telescope mounted in a Boeing 747 aircraft, is being developed for NASA by a consortium consisting of the University Space Research Association, Raytheon E-Systems, and United Airlines. This new facility will be a replacement for the retired Kuiper Airborne Observatory that used to fly out of Moffett Field. As part of this development, NASA Ames Research Center is providing an instrument that will measure the integrated amount of water vapor seen along the telescope line of sight. Since the presence of water vapor strongly affects the astronomical infrared signals detected, such a water-vapor monitor is critical for proper calibration of the observed emission. The design of the water-vapor monitor is now complete, and engineering model units (EMUs) have been constructed for all of the important subassemblies.

The SOFIA water-vapor monitor measures the water-vapor content of the atmosphere integrated along the line of sight at a 40-degree elevation angle by making radiometric measurements of the center and wings of the 183.3-GHz rotational line of water. These measurements are then converted to the integrated water vapor along the telescope line of sight. The monitor hardware consists of three physically distinct subsystems:

1. The radiometer head assembly contains an antenna that views the sky, a calibrated reference target, a radio-frequency (RF) switch, a mixer, a local oscillator, and an intermediate-frequency (IF) amplifier. All of these components are mounted together and are attached to the inner surface of the aircraft fuselage, so that the antenna can observe the sky through a microwave-transparent window. The radiometer and antenna were ordered from a commercial vendor and modified at Ames to include an internal reference calibrator. Laboratory tests of this subassembly have indicated a signal-to-noise performance over a factor of two better than required.

2. The IF converter box assembly consists of IF filters, IF power splitters, RF amplifiers, RF power meters, analog amplifiers, analog-to-digital (A/D) converters, and an RS-232 serial interface driver. These electronics are mounted in a cabinet just under the radiometer head and are connected to both the radiometer head and the water-vapor monitor CPU. Engineering model units for all the important components in this subassembly, including the entire RF signal chain, the RF detectors, and the low-noise power supplies, have been constructed and tested in the lab. All easily meet their allocated performance requirements.

3. A host CPU converts the radiometer measurements to measured microns of precipitable water and communicates with the rest of the SOFIA mission and communications control system. A nonflight version of this computer has been procured for development and laboratory testing, and the software architecture has been defined. Coding of prototype software has started, and communications between the host CPU and the IF converter box assembly have been demonstrated.

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